

On Copepoda associated with Dutch molluscs ¹⁾

by

J. H. STOCK

Zoölogisch Museum, Amsterdam

It is known for more than a century already that molluscs are appropriate hosts for Copepoda. Since we are in many cases uncertain what relation exactly exists between the mollusc and the copepod, terms like "parasite", "semi-parasite" and "commensal" can better be avoided and the more neutral term "associate" used instead. MONOD & DOLLFUS summarized in 1932 all previous literature on copepods associated with molluscs. HUMES estimated in 1958 the number of copepods known to live on or in molluscs, at over 100 species, divided over about 60 genera. These copepods do not form a systematic unity, but belong to different groups; the greater part of them have been classified with the Cyclopoida, although all other copepod orders, with the exception of the Calanoida, include associated forms. In the last few years several dozens of new species have been described, the total number of copepods associated with molluscs being therefore may be 50% higher than HUMES' estimate.

The hosts belong to the classes Gastropoda, Cephalopoda and Lamellibranchia; from the Monoplacophora, Amphineura and Scaphopoda no copepods became known hitherto. All hosts are marine, except for one case of infection of an African brackish water *Congeria* (cf. HARDING, 1963).

¹⁾ This paper is respectfully dedicated to Mrs. W. S. S. van der Feen-van Benthem Jutting on the occasion of her 65th anniversary.

One can find among these associates every transition from forms hardly adapted to the special mode of life (often considered only as "messmates" or "commensals") to fully and unrecognizably transformed animals, real internal parasites. For instance, *Teredoika serpentina* Stock, 1959, living in the stomach of *Teredo utriculus* Gm. from the Gulf of Naples, has lost all appendages; this species is recognizable only as a copepod from the less modified larval stages.

Since some species cause damage to commercially important molluscs, the study of these associates is not devoid of economic interest. The enormous damage caused by *Mytilicola intestinalis* Steuer, 1902, during the last 14 years to mussel cultures in western Europe, might in this context be brought in mind.

Although our Dutch malacofauna certainly cannot be called a poor one, the total number of copepods known to be associated with molluscs in our faunal region is very limited (compare table I). In contrast with this, table II lists the autochthonous Dutch molluscs — as far as they are parasitized — with their characteristic associated copepods, based on observations made outside the Netherlands. From table II it is evident that much faunistic research in this field is still necessary in our area. As standard for the autochthonous occurrence of the molluscs listed in the tables, I relied upon data published by VAN BENTHEM JUTTING (1933 and 1943), BLOKLANDER (1952) and SWENNEN (1961). It may be repeated that only those mollusc-species, from which associates are known in extraterritorial waters, have been included in table II.

Table I. Autochthonous molluscs with their associated copepods known from Dutch waters

| Host | Associated copepod | Authority |
|---|---|---|
| <i>Aeolidia papillosa</i> (L.), dorsal papillae | <i>Doridicola</i> (or <i>Lichomolgus</i>) <i>agilis</i> Ley dig. 1853 | Stock, 1952 |
| <i>Sepia officinalis</i> L., gills | <i>Lichomolgus longicauda</i> (Claus, 1860) | Stock, 1956 |
| <i>Mytilus edulis</i> L., gills | <i>Modiolicola insignis</i> Aurivillius, 1882 | Stock, 1950; Korringa, 1951; |
| the same, intestines | <i>Mytilicola intestinalis</i> Steuer, 1902 .. | Stock & de Vos, 1960 |
| <i>Ostrea edulis</i> L., gut | <i>Mytilicola intestinalis</i> Steuer, 1902 .. | Korringa, 1950 and several later publications |
| <i>Cardium edule</i> L., pallial cavity | <i>Paranthesius</i> (Hermannella) <i>rostratus</i> (Canu, 1891) | unpublished (Zeeland) |
| <i>Venus galina striata</i> (Da C.), pallial cavity | <i>Leptinogaster</i> spec. | Stock, 1950; De Vos & Stock, 1960 |
| <i>Venerupis pullatrix</i> (Mont.), pallial cavity .. | <i>Paranthesius</i> (H.) <i>rostratus</i> (Canu, 1891) | unpublished (IJmuiden, Noorderstrand) |
| <i>Spisula subtruncata</i> (Da C.), pallial cavity .. | <i>Paranthesius</i> (H.) <i>rostratus</i> (Canu, 1891) | unpublished (Texelstrom) |
| <i>Abra alba</i> (W. Wood), pallial cavity | <i>Leptinogaster bistris</i> (Pelseneer, 1929) | Bocquet & Stock, 1958 |
| <i>Macoma balthica</i> (L.), pallial cavity | <i>Leptinogaster bistris</i> (Pelseneer, 1929) | Bocquet & Stock, 1958; Stock & de Vos, 1960 |
| the same, pallial cavity | <i>Paranthesius</i> (H.) <i>rostratus</i> (Canu, 1891) | Stock, 1959 |

Table II. Autochthonous molluscs with their associated copepods known from foreign waters

| Host | Associated copepod | Distribution of the associate in the host mentioned |
|--|--|---|
| Class GASTROPODA | | |
| <i>Callistoma zizyphinum conuloides</i> (Lam.), rectal gland | <i>Endocheres obscurus</i> Bocquet & Stock, 1956 | Brittany |
| the same, rectum | <i>Trochicola entericus</i> Dollfus, 1914 | Normandy |
| <i>Odonotoma scalaris</i> (Maggiolivray), pallial cavity | <i>Monstrilia belgolandica</i> Claus, 1863 | Boulognais |
| <i>Crepidula fornicata</i> (L.), gut | <i>Mytilicola intestinalis</i> Steuer, 1902 | England (experimental infection) |
| the same, gut | <i>Mytilicola orientalis</i> Mori, 1935 | California |
| <i>Buccinum undatum</i> L., body surface | <i>Anthersius seistis</i> Bocquet & Stock, 1958 | Channel coast of France |
| <i>Archidoris tuberculata</i> (Cuvier), gills | <i>Doridicola agilis</i> Leydig, 1853 | European coasts from Sweden to the Mediterranean |
| the same, coelom | <i>Splanchnorophus</i> spec. | Arcachon |
| <i>Jorunna tomentosa</i> (Cuvier), gills | <i>Doridicola agilis</i> Leydig, 1853 | Boulognais |
| <i>Acanthodoris pilosa</i> (Abildg. in Müll.), coelom | <i>Splanchnorophus gracilis</i> Hancock & Norman, 1863 | England |
| <i>Ancula cristata</i> (Alder), coelom | <i>S. willemi</i> Canu, 1891 | Atlantic coast of France |
| <i>Doto coronata</i> (Gmelin), coelom | <i>S. brevipes</i> Hancock & Norman, 1863 | England |
| the same, dorsal papillae | <i>Doridicola agilis</i> Leydig, 1853 | No locality (Pelseneer, 1928) |
| <i>Coryphella verrucosa</i> (M. Sars), coelom | <i>Splanchnorophus brevipes</i> Hancock & Norman, 1863 | England |
| <i>Facelina coronata</i> (Forbes & Goodsir), coelom | <i>S. willemi</i> Canu, 1891 | Atlantic coast of France |
| the same, dorsal papillae | <i>Doridicola agilis</i> Leydig, 1853 | Roussillon, Atlantic coast of France, Norway |
| <i>Antiopea cristata</i> (D.Ch.), dorsal papillae | <i>Doridicola agilis</i> Leydig, 1853 | England, Atlantic coast of France |
| <i>Aeolidiella glauca</i> (Alder & Hancock), coelom | <i>Splanchnorophus angulatus</i> Hecht, 1893 | Brittany |
| <i>Aeolidiella papillata</i> (L.), coelom | <i>Splanchnorophus angulatus</i> Hecht, 1893 | Brittany |

| Host | Associated copepod | Distribution of the associate in the host mentioned |
|--|--|---|
| Class CEPHALOPODA | | |
| <i>Bedone morchata</i> (Lam), gills | ? <i>Penella varians</i> Sp. & Lütken, 1861 | Adriatic Sea |
| <i>Loligo vulgaris</i> Lam., gills | ? <i>Penella varians</i> Sp. & Lütken, 1861 | Adriatic Sea |
| <i>Ommatostrephes sagittatus</i> (Lam), gills | ? <i>Doridicola sagittis</i> Leydig, 1853 | Costa Brava |
| <i>Octopus vulgaris</i> Lam., body surface | ? <i>Ocipicola s. superbus</i> Hunnes, 1957 | Baayuls, Brittany |
| Class LAMELLIBRANCHIA | | |
| <i>Molibus molibus</i> (L.), gills | ? <i>Modicicola insignis</i> Auriarillius, 1882 | North Sea Region |
| <i>Mitilus edulis</i> L., pallial cavity | ? <i>Tubae celata</i> Hunnes, 1954 | New Brunswick |
| the same, gut | ? <i>Pseudomyicola spinosus</i> (Raff. & Montic., 1885) | Mediterranean |
| the same, intestines | ? <i>Mytilicola orientalis</i> Mori, 1935 | California |
| <i>Pectens maximus</i> (L.), pallial cavity | ? <i>Paranthesiss maximus</i> (Thompson, 1893) | England |
| <i>Chlamys varia</i> (L.), pallial cavity | ? <i>Paranthesiss (Hermannella) pectinis</i> | Brittany, England |
| <i>Chlamys opercularis</i> (L.), pallial cavity | ? <i>Paranthesiss (H.) pectinis</i> (Pesta, 1909) | Atlantic coast of France |
| the same, pallial cavity | ? <i>Paranthesiss inermis</i> (Canu, 1891) | Atlantic coast of France |
| the same, rectum | ? <i>Trochicola pectinidarium</i> Tuzet & Ornières, 1961 | Sète (S. France) |
| <i>Ostrea edulis</i> L., gills | ? <i>Paranthesiss (Hermannella) ?barnea</i> | French Channel coast |
| <i>Laevicardium crassum</i> (Gmelin), gills, in <i>Lichomolgus lepidermatus</i> Goedding, 1957 | (Pelseneer, 1929) | English and French Channel coasts |
| <i>Cardium edule</i> L., gut | ? <i>Paranthesiss (H.) haplocera</i> Bocquet & Stock, 1959 | England, Brittany |
| <i>Cardium edule</i> L., gut | ? <i>Mytilicola intestinalis</i> Steuer, 1902 | England |
| <i>Cardium edule</i> L., pallial cavity | ? <i>Conchylisurus cardis</i> Goedding, 1957 | English and French Channel coasts |
| <i>Dosinia exoleta</i> (L.), gut | ? <i>Mytilicola intestinalis</i> Steuer, 1902 | Brittany |
| the same, gills | ? <i>Anthessia arenicola</i> (Brady, 1872) | Brittany |

| Host | Associated copepod | Distribution of the associate in the host mentioned | |
|--|---|--|--|
| <i>Venerupis pullastra</i> (Mont.), pallial cavity | <i>Conchyliaurus cardis tapetis</i> Bocquet & Stock, 1958 | Brittany | |
| the same, gut | <i>Mytilicola intestinalis</i> Steuer, 1902 | England, experimental infection | |
| <i>Spirula solida</i> (L.), pallial cavity | <i>Paranthesioides (Hermannella) rostratus</i> (Canu, 1891) | Brittany | |
| <i>Macra corallina cinerea</i> Mont., pallial cavity | <i>Paranthesioides (H.) rostratus</i> (Canu, 1891) | French Channel coast | |
| <i>Littorina littorea</i> (L.), pallial cavity | <i>Paranthesioides (H.) rostratus</i> (Canu, 1891) | Brittany | |
| <i>Solea marginatus</i> Mont., pallial cavity | <i>Paranthesioides (H.) rostratus</i> (Canu, 1891) | Brittany | |
| the same, pallial cavity | <i>Conchyliaurus solensis</i> Bocquet & Stock, 1957 | Brittany | |
| <i>Ensis siliqua</i> (L.), pallial cavity | <i>Anthèresius minor</i> Stock, 1959 | Naples | |
| the same, pallial cavity | <i>Paranthesioides (H.) rostratus</i> (Canu, 1891) | Brittany | |
| <i>Mya arenaria</i> L., pallial cavity | <i>Myicola metiensis</i> Wright, 1885 | Atlantic coast of U.S.A. | |
| the same, pallial cavity | <i>Lepinogaster major</i> (Williams, 1907) | Atlantic coast of U.S.A. | |
| <i>Barnesia candida</i> (L.), pallial cavity | <i>Paranthesioides (Hermannella) barnesiæ</i> (Pelseneer, 1929) | Boulognais | |
| <i>Pbolas dactylus</i> L., pallial cavity | <i>Paranthesioides (H.) barnesiæ</i> (Pelseneer, 1929) | Brittany | |
| the same, pallial cavity | <i>Leptinogaster pholadis</i> Pelseneer, 1929 | Naples, Brittany | |

LITERATURE CITED

BENTHEM JUTTING, T. VAN, 1933. Mollusca (I) A. Gastropoda prosobranchia et pulmonata. Fauna Ned., vol. 7 (Leiden, Sijthoff).

—, 1943. Mollusca (I) C. Lamellibranchia. Fauna Ned., vol. 12 (Leiden, Sijthoff).

BLOKLANDER, A., 1952. Naamlijst van Nederlandse mariene Mollusken. Zeepaard, vol. 12, no. 6, pp. 83-99.

BOCQUET, C., & J. H. STOCK, 1958. Sur trois genres synonymes de Copépodes Cyclopoides, *Leptinogaster* Pelseneer, *Strongylopleura* Pelseneer et *Myocheres* Wilson (Clausidiidae). Arch. Zool. exp. gén., vol. 96, N. & R. 2, pp. 71-89.

HARDING, J. P., 1963. The evolutionary history of a copepod now parasitic in a mollusc. Proc. XVI intern. Congr. Zool., vol. 1, p. 147.

HUMES, A. G., 1958. Copepod parasites of mollusks. Ann. Reps. Amer. malac. Un., 1957, pp. 13-14.

KORRINGA, P., 1950. De aanval van de parasiet *Mytilicola intestinalis* op de Zeeuwse mosselcultuur. Viss.-Nieuws, no. 7 (suppl.), pp. 1-7.

—, 1951. Over *Mytilicola intestinalis* (Copepoda parasitica) en enkele andere ongewenste vreemdelingen in onze wateren. Vakbl. Biol., vol. 31, no. 4, pp. 63-74.

MONOD, Th., & R. Ph. DOLLFUS, 1932. Les Copépodes parasites de Mollusques. Ann. Parasitol., vol. 10, no. 2, pp. 129-204.

STOCK, J. H., 1950. Parasiet veroorzaakt massa-sterfte onder de mossels. Zeepaard, vol. 10, no. 6, pp. 87-89.

—, 1952. On a semi-parasitic copepod from a Dutch nudibranch. Basteria, vol. 16, no. 4, pp. 58-59.

—, 1956. *Lichomolgus longicauda* (Claus, 1860), copepod parasite of *Sepia*, in the North Sea. Beaufortia, vol. 5, no. 53, pp. 117-120.

—, 1959. Copepoda associated with Neapolitan Mollusca. Pubbl. Staz. zool. Napoli, vol. 31, no. 1, pp. 43-58.

STOCK, J. H., & A. P. C. DE VOS, 1960. Einige wirbellose Tiergruppen des Dollart-Ems-Estuariums. Verh. kon. Ned. geol. mijnbk. Gen., (geol.) vol. 19, pp. 203-220.

SWENNEN, C., 1961. Data on distribution, reproduction and ecology of the nudibranchiate molluscs occurring in the Netherlands. Neth. J. Sea Res., vol. 1, no. 1-2, pp. 191-240.